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Roentgenographic Study of the Volume of the Sella Turcica

Part 1. Roentgen Anatomical Study

By

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トルコ鞍容積のX線学的研究 (第1報)

X線解剖学的研究

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著者は、昨年来X線学的容積に関する報告を行ひ、その目的並びに意義については既に述べたが、本論文はそのX線解剖学的問題点を取りあげ、若干の文献考察と共に容積計測法の基礎的根拠を報告する。

目的：トルコ鞍上界及び側境界の決定。

材料：死体頭部 20例。

方法：肉眼的観察に加え、単純及び造影剤使用によるX線撮影を行った。

結果：1. 鞍隔膜は、鞍結節、鞍背、前後床突起に附着しており、鞍の上界として最適である。2. 脳下垂体の幅は鞍床とほぼ一致しており、鞍の両側境界としては、鞍床端からの垂直線が適当と思われる。

General Consideration

The central portion of the middle cranial fossa is occupied principally by a peculiarly shaped small depression on the body of the sphenoid bone, named the sella turcica (pituitary fossa), in which the pituitary body (hypophysis cerebri) is lodged as the center of the endocrine system (Fig. 1). The sella turcica is, as well understood, very important and significant in the roentgen diagnosis, not only of the intracranial diseases, but of the many others.

Therefore, numerous studies of this structure have been carried out by various workers, since the end of the last century. In spite of this early beginning of the study, the roentgen-volumetric studies on the sella turcica could be found in only few literatures, and no literature has been noted on the volume difference of age and sex.

The roentgen-volumetric study of the sella turcica is of great importance in the following ways, especially as for the fundamental knowledge in the roentgen diagnosis.

A. For Academic Studies

1. The establishment of normal values in Japanese.
2. Growth and anthropological studies.

B. For Clinical Studies

1. The objective assessment of the pathological sella.
2. The anticipation of the size of the pituitary gland and its function.
3. For the safe and effective pituitary gland implantation of radioactive seeds.

Recently, the author¹⁰⁾¹¹⁾¹²⁾ reported on the volume of the sella turcica, where an experimental formula for estimating the sellar volume was proposed, and roentgenographic normal values were estimated by using the author's formula.

The purpose of this serial study is to describe some minute details on the sellar volume by the author's method.

Roentgen Anatomical Study

In order to describe exactly the roentgenographic volume of the sella turcica, an accurate knowledge of this structure is required, and also, some important roentgen anatomical problems should be resolved. One of them is the true determination of three dimensions, namely, the upper and lateral borders of the sella turcica. The sella is bounded anteriorly, inferiorly and posteriorly by the osseous, so it is not difficult to determine their boundaries. There are, however, no landmarks to determine easily the upper and lateral borders.

There are many literatures pertaining on the anatomy and roentgen anatomical study on the sella turcica, but very few are available for the volumetric study. Moreover, reviewing the literature, the author found several disagreeable important points, and very few literatures describing the exact relationship between the diaphragma sellae and the roentgenographical landmarks in the sella turcica, and the relationship between the width of the pituitary and the width of the sella turcica.

This paper chiefly aims to demonstrate these roentgenographical relationships and to show the roentgen anatomical background of author's method.

Object

1. Demonstration of the position of the diaphragma sellae.
2. Demonstration of the anatomical and roentgenographical relation of the width between the sella turcica and pituitary gland.

Material and Method

Material: 20 fresh cadavers with removed brain.

Method:

1. In addition to macroscopical observation, first the roentgenograms were taken laterally and straight postero-anteriorly (Fig. 4)
2. The diaphragma was incised in twelve cases, and the pituitary gland was removed carefully as not to break the cavernous sinus. The vacuum was packed by the contrast media (barium sulfate) and again roentgenograms were taken.
3. The skulls were sawn on the sagittal or frontal mid section and divided into two parts for further macroscopic observation.

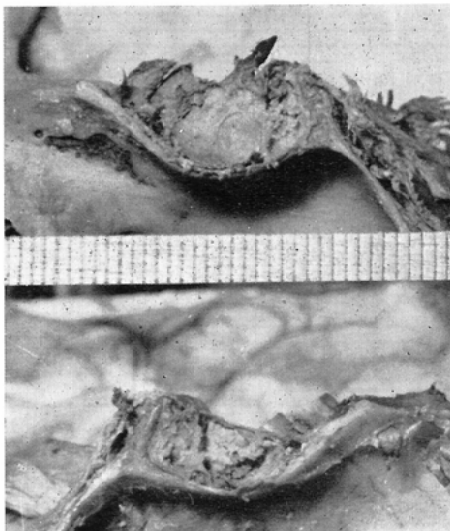
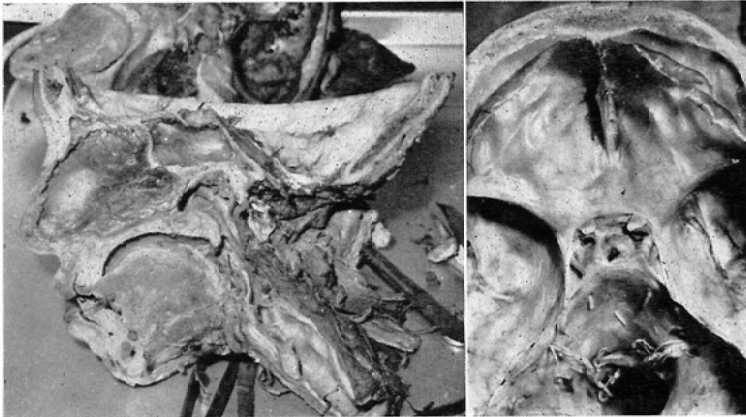
Result

1. The position of the diaphragma sellae.

The diaphragma sellae was found to be attached to the most anterior convexity of the posterior clinoid processes, slightly below the top of the dorsum sellae, just below the tip of the tuberculum sellae, and the most posterior convexity of the anterior clinoid processes, in both lateral roentgenograms and macroscopic observations.

The gross appearance of the sella turcica and its surrounding structures in the skull are shown in Fig. 1. The position of the diaphragma sellae is clearly demonstrated on the magnified photographs (Fig. 2). The pituitary gland and its relation to the diaphragma are also shown in Fig. 2. Fig. 2C is the diagram of Fig. 2B. All the skulls of the cadavers demonstrate the same relationship between the diaphragma sellae and the sella turcica (Fig. 3).

Fig. 1

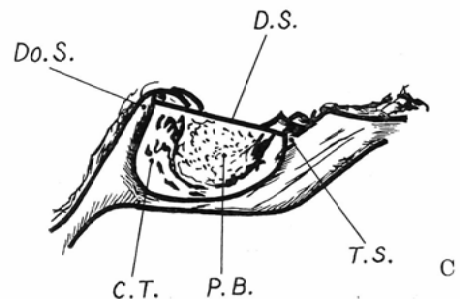


A

B

Fig. 2

D.S. Diaphragma sellae
T.S. Tuberculum sellae
P.B. Pituitary Body
C.T. Connective Tissue
Do. S. Dorsum sellae



C

Fig. 3



Fig. 4

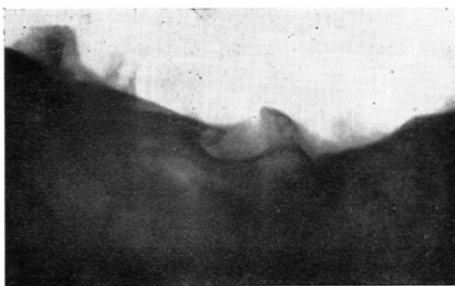


Fig. 5

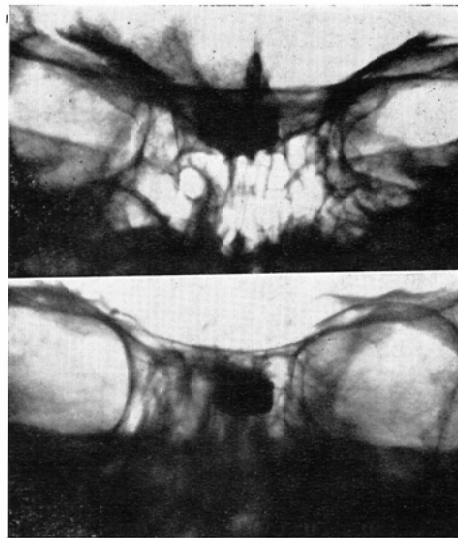
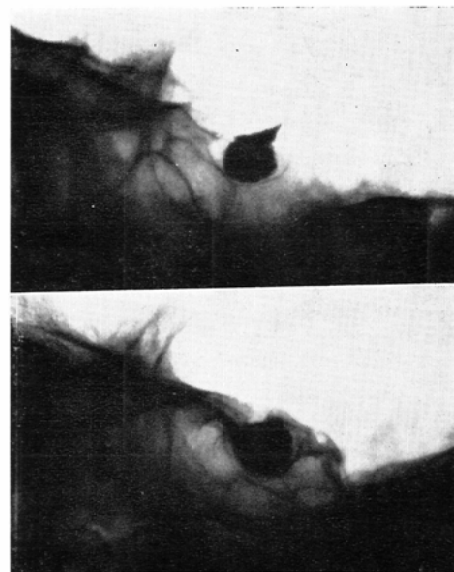


Fig. 6



The lateral skull roentgenogram of the cadavers with removed brain presents the sharp demarcation of the diaphragma sellae (Fig. 4).

2. The relation of the width between the sella turcica and the pituitary gland.

The opaque media, represented the pituitary gland, is found to correspond with the sellar floor rather than with the waist of the dorsum sellae (Fig. 5). There are some discrepancies from 0 to 2 mm between the opaque media and the sella. Lateral views with the opaque media also show the position of the diaphragma and the discrepancies between the sella turcica and the pituitary gland (Fig. 6). This is an anticipatable fact, because the contents of the sella are not only composed of the pituitary gland, but other components. These relationships are also observed macroscopically in the frontal sections of the sella turcica.

Discussion

The sella turcica is not a really enclosed box. There are no bony walls on the upper and both lateral sides of the sella turcica. The roof of the sella turcica is formed by a fold of the dura mater, which is known as the diaphragma sellae. Many authors described the diaphragma sellae as the upper limit of the sella turcica. Reviewing the literature, the author, however, could only find ambiguities and confusions concerning the roentgen anatomical relation between the diaphragma sellae and the sella turcica (Table 1).

Table 1. The Position of the Diaphragma sellae

Author	Year	Anterior Attachment	Posterior Attachment
Johnston ⁽¹⁾	1916	anterior clinoid process	posterior clinoid process
Howe ⁽²⁾	1919	tuberculum sellae	posterior clinoid process
Scheuermann ⁽³⁾	1932	anterior clinoid process	posterior clinoid process
Kornblum ⁽⁵⁾	1932	tuberculum sellae	top of dorsum sellae
Meschan ⁽⁷⁾	1955	tuberculum sellae	top of dorsum sellae
Pendergrass, Schaeffer, and Hodes ⁽⁸⁾	1955	anterior clinoid process	posterior clinoid process top of dorsum sellae
Mahmoud ⁽⁶⁾	1958	tuberculum sellae anterior clinoid process	upper margin of dorsum sellae posterior clinoid process
Block and Joplin ⁽¹⁾	1959	tuberculum sellae	most anterior convexity of posterior clinoid process
Shapiro and Janzen ⁽¹³⁾	1960	tuberculum sellae	top of posterior clinoid process
Di Chiro ⁽²⁾	1960	tip of tuberculum sellae	top of dorsum sellae

The author's study resulted in the approximate agreement with Mahmoud's description.⁽⁶⁾ Namely, the diaphragma sellae was attached, with slight concave, to the posterior clinoid process, which is slightly below the top of the dorsum sellae, just below the tuberculum sellae, and the anterior clinoid process. The position of the diaphragma in the sagittal mid section was between the tuberculum sellae and the dorsum sellae.

For the determination of the lateral boundaries of the sella turcica, the author tried to understand the relationship between the width of the sella turcica and the pituitary gland. Relationship between them was reported to correspond with the "waist" of the dorsum sellae⁽¹⁾ or the sellar floor.⁽²⁾ In this series, the width of the pituitary gland approximately corresponded with that of the sellar floor, although the sella turcica, of course, does not correspond exactly to the shape and to the size of the pituitary gland (This problem is to be discussed in Part 3).

For the measurement of the sellar width, the floor is considered to be the most suitable and reasonable portion.

Summary

1. Roentgen anatomical study of the sella turcica was carried out with using the skulls of the cadavers.
2. The diaphragma sellae, seemed to be the upper border of the sella, was attached to the posterior clinoid process, the dorsum sellae, the tuberculum sellae, and the anterior clinoid process.
3. Lateral borders of the sella were considered to be a line vertically drawn from the edges of the sellar floor, because the width of the pituitary gland corresponded with that of the sellar floor.

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